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**Southwestern
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Forest Pest Management Report

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**ANNUAL SOUTHWESTERN REGION
FOREST INSECT AND DISEASE
CONDITIONS REPORT
1993**

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ANNUAL SOUTHWESTERN REGION FOREST INSECT AND DISEASE CONDITIONS REPORT 1994

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By

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FORWARD

The status of major insects and diseases in Southwestern forests in 1993 is summarized in this report. Much of the information is based on aerial and ground surveys conducted by Forest Pest Management Specialists, Southwestern Region, and State Pest Management Specialists of the Division of Forestry, Arizona State Land Department, and the New Mexico Department of Agriculture. These surveys report short-term changes in pest activity, as well as indicating long-term trends when compared to previous surveys.

As in the past, Forest Pest Management Specialists have compiled the information for lands of all ownerships; if required, further information and additional copies of this publication are available upon request.

ACKNOWLEDGEMENTS

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Conditions in Brief

In the Southwest, approximately 58,145 bark beetle-killed trees were observed on 44,170 acres of Federal land in 1993. This represents a net increase in the number of acres of beetle-killed trees (32,920 acres) from 1992. Within the ponderosa pine forest cover type, roundheaded pine beetle in combination with the western pine beetle and Mexican pine beetle caused the majority of the tree mortality with 40,620 "faders" being counted and volume losses estimated at 1,878,500 cubic feet, followed by Ips engraver beetle with approximately 3,805 "faders" and 114,150 cubic feet, and mountain pine beetle with 1,865 "faders" and 93,250 cubic feet. In the mixed conifer and spruce forest cover types, Douglas-fir beetle and fir engraver beetle attacks caused an estimated 93,750 and 246,800 cubic feet of volume loss, respectively, and spruce beetle, 62,500 cubic feet of volume loss. Attacks by Douglas-fir beetle, fir engraver beetle, and spruce beetle created approximately 9,295 "faders".

Insect defoliator activity Regionwide increased from 41,510 acres in 1992 to 83,620 acres in 1993. Most of this defoliation (66,400 acres) was due to western spruce budworm larval feeding. The remainder of the defoliation (17,220 acres) was caused by a complex of large aspen tortrix, western tent caterpillar, and Marssonina leaf blight, and hail damage.

Dwarf mistletoes continued to be the primary cause of growth loss, excluding densely stocked stands, in both mixed conifer and ponderosa pine cover types. They are estimated to cause an annual conifer volume loss of 25 million cubic feet. Both direct and indirect evidence suggests that the incidence and severity of these parasites has increased during this century.

The most common root rots in the Region are Armillaria spp. and Heterobasidion annosum. They are responsible for 5 million cubic feet of annual volume loss and create hazard trees in campgrounds and along roadways. Incidence in mixed conifer and spruce fir cover types is higher than in the pine cover type. Similar to other indigenous diseases, root and butt rots can be beneficial to some wildlife species because they create snags and downed logs.

White pine blister rust occurs throughout the range of southwestern white pine on three Ranger Districts of the Lincoln National Forest and the Mescalero Apache Indian Reservation in New Mexico. It has not been detected elsewhere in the Region.

STATUS OF PREDOMINANT INSECTS IN 1993

Roundheaded pine beetle, Dendroctonus adjunctus, western pine beetle, Dendroctonus brevicomis, and larger Mexican pine beetle, Dendroctonus approximatus

Tree mortality caused largely by roundheaded pine beetle activity and sometimes in combination with western and Mexican pine beetles increased from 22,190 acres in 1992 to 34,170 acres in 1993. As in 1992, most of the mortality occurred in the Sacramento Mountains on the Lincoln National Forest, (15,370 acres) and the Mescalero Apache Indian Reservation (16,750 acres), in New Mexico. Roundheaded pine beetle activity in the Pinaleno Mountains of Arizona increased from approximately 750 acres in 1992 to 2,050 acres in 1993. In addition to roundheaded pine beetle, small pockets of western pine beetle mortality were found there as well. Other areas of western pine beetle mortality include the Cibola (1,490 acres), Gila (250 acres), Apache-Sitgreaves (170 acres), Kaibab (80 acres), and Tonto (300 acres) National Forests and the Ft. Apache Indian Reservation (10 acres). Volume losses resulting from these bark beetles were estimated at 2,006,500 cubic feet.

Western spruce budworm, Choristoneura occidentalis

Defoliation caused by the larvae of the western spruce budworm increased from 20,960 acres in 1992 to approximately 68,300 acres in 1993. Defoliation on Federal lands included the Carson (11,720 acres), Lincoln (240 acres), and Santa Fe (20,200 acres) National Forests, and the Jicarilla Apache Reservation (80 acres), Navajo Indian Reservation (1,520 acres), the Santa Clara Indian Reservation (200 acres), and the Taos Pueblo Indian Reservation (800 acres). Budworm defoliation on State and private lands in northern New Mexico was aerially detected on 31,690 acres in Catron (200 acres), Cibola (1,000 acres), Colfax (18,140), McKinley (300 acres), Mora (4,450 acres), Rio Arriba (4,750 acres), Sandoval (350 acres), and Taos Counties. In addition, ground surveys by Bernalilo District Forestry personnel detected another 640 acres of defoliation previously undetected in Cibola County.

Other insect activity of lesser magnitude occurring in the Region in 1993 are summarized below.

Table 1. Status of other insects occurring in Arizona and New Mexico in 1993

Insect	Host	Location	Remarks
Douglas-fir beetle *Dendroctonus pseudotsugae*	Douglas-fir	Arizona, New Mexico	Douglas-fir beetle activity decreased slightly Regionwide from a total of 2,230 acres in 1992 to 1,160 acres in 1993. Small group tree mortality (2 to 10 trees) occurred on the Apache-Sitgreaves, Coconino, Coronado, and Kaibab National Forests, Arizona; and the Cibola, Lincoln, and Santa Fe National Forests and the Mescalero Apache Indian Reservation and Navajo Indian Reservation, New Mexico. Losses resulting from Douglas-fir beetle attacks in 1993 approximated 93,750 cubic feet of volume Regionwide. On State and private lands, tree mortality from these bark beetles continued at low levels in Colfax and San Miguel counties, New Mexico.
Douglas-fir tussock moth *Orgyia pseudotsugata*	Douglas-fir	New Mexico Arizona	No tussock moth defoliation was detected on Federal lands in Arizona or New Mexico. On State and private lands in New Mexico, minor tussock moth injury occurred on ornamental spruce trees in Santa Fe, Los Alamos, and White Rock. No forest infestations were detected.
Fall webworm *Hyphantria cunea*	Siberian elms Cottonwoods	New Mexico Arizona	No fall webworm defoliation was reported on Federal lands in New Mexico or Arizona. However, fall webworm was common in sandscape and lower elevation hardwoods on State and private lands throughout New Mexico.

Table 1. Status of other insects occurring in Arizona and New Mexico in 1993

Insect	Host	Location	Remarks
Mountain pine beetle *Dendroctonus ponderosae*	Ponderosa pine	New Mexico	Mountain pine beetle-caused ponderosa pine mortality increased slightly from 1,170 acres in 1992 to 1,400 acres in 1993. Mortality occurred on the Santa Fe National Forest, Bandalier National Monument, and the Navajo Indian Reservation, New Mexico. Volume losses resulting from these bark beetles were estimated at 93,250 cubic feet Regionwide.
Pandora moth *Coloradia pandora*	Ponderosa pine	Arizona	No pandora moth defoliation was detected in 1993.
Pine engraver beetles *Ips* spp.	Ponderosa pine	Arizona, New Mexico	Ponderosa pine mortality resulting from pine engraver beetle attacks decreased from 3,830 acres in 1992 to 1,630 acres in 1993. Small groups of fading trees (2 to 10 trees per spot) and occasional large group tree mortality (25 trees and larger) occurred on the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests, and the San Carlos Apache and Hualupai Indian Reservations, Arizona; and Cibola, Gila, Lincoln, and Santa Fe National Forests and Navajo and Santa Clara Indian Reservations, New Mexico. Volume loses on Federal lands

Table 1. Status of other insects occurring in Arizona and New Mexico--continued

Insect	Host	Location	Remarks
			Regionwide were estimated at 114,150 cubic feet. On State and private lands in New Mexico, Ips beetles caused extensive tree mortality in pole sized trees thinned in the fall of 1992 near Mt. Taylor. Damage occurred in pockets ranging from one to twenty trees. High Ips populations in storm damaged trees occurred at the Rancho del Chapparel Girl Scout Ranch. About 50 acres were infested. These bark beetles also caused top-killing of large high value ponderosa pines in the Cloudcroft and Ruidoso areas.
Pine sawflies Zadiprion spp. Neodiprion spp.	Ponderosa pine Pinyon pine	New Mexico	Winter-feeding larvae of Zadiprion townsendii defoliated trees on State private lands in Santa Fe, Cedar Crest, Manzano, and Mountainaire. No Neodiprion species were detected this year.
Pinyon pine needle scale Matsucoccus acalyptus	Pinyon pine	New Mexico Arizona	On State and private holdings, damage to landscape pinyons by this scale insect was common statewide. Some defoliation by this insect was detected on state and private lands near Prescott, Arizona. No pinyon needle scale infestations were detected on Federal lands in 1993.

Table 1. Status of other insects occurring in Arizona and New Mexico--continued

Insect	Host	Location	Remarks
Pinyon pine needle miner *Coleotechnites educola*	Pinyon pine	New Mexico	Defoliation by pinyon needle miner has reportedly increased on State and private lands on the north side of Santa Fe and decreased on the south and east side of the city. No other outbreaks were noted in 1993.
Pine tip moths *Rhyacionia spp.*	Ponderosa Pine	New Mexico	Southwestern pine tip moth populations were down at the research pndorosa pine plantation in Mora. Nantucket pine tip moth activity was detected for the first time at a southside Santa Fe neighborhood, causing extensive damage to ponderosa pine. This insect continues to seriously deform young landscape ponderosa pines in Albuquerque and southern New Mexico.
Twig beetles *Pityophthorus spp.*	Ponderosa Pine	New Mexico Arizona	Twig beetle populations caused extensive damage to several hundred acres of ponderosa pines on private lands north of Las Vegas. Twig beetles continue to be a major problem in landscape pines and the main cause of balled and burlapped ponderosa and pinyon pine mortality.

Table 1. Status of other insects occurring in Arizona and New Mexico--continued

Insect	Host	Location	Remarks
Ponderosa pine needle miner *Coleotecnites ponderosae*	Ponderosa pine	New Mexico	Ponderosa pine needle miner defoliation in San Miguel county dramatically decreased from 2,960 acres in 1992 to only 80 acres in 1993. Some light needle minor defoliation was also reported around Los Alamos.
Prescott Scale *Matsucoccus vexillorum*	Ponderosa pine	Arizona	Branch dieback, caused by Prescott Scale, continued to occur on the Fort Apache Indian Reservation.
Spruce beetle *Dendroctonus rufipennis*	Spruce	Arizona New Mexico	Spruce beetle-caused tree mortality increased from 1,055 acres in 1992 to 1,180 acres in 1993. Scattered groups of dead fading trees (two to five trees per spot) occurred on the Coronado and Kaibab National Forests, Arizona; and the Cibola, Lincoln, and Santa Fe National Forests, Mescalero Apache and Navajo Indian Reservations, New Mexico. Current years volume losses from spruce beetle attacks approximated 62,500 cubic feet.
White fir needle miner *Epinotia meritana*	White fir	Arizona	No white fir needle miner defoliation was detected in the Region in 1993. This was the second year for this trend.

Table 1. Status of other insects occurring in Arizona and New Mexico--continued

Insect	Host	Location	Remarks
PEST COMPLEXES			
Aspen defoliation			
Large aspen tortrix *Choristoneura conflictana* Western tent caterpillar *Malacosoma californicum* Marssonina leaf blight *Marssonina populi*	Aspen	Arizona, New Mexico	Defoliation caused by this insect and disease complex decreased Regionwide from 20,550 acres in 1992 to 17,220 in 1993. Pockets of aspen defoliation occurred on the Apache--Sitgreaves, Coconino, Coronado, Kaibab National Forests, and Fort Apache Indian Reservation, Arizona; the Carson, Cibola, Gila, Lincoln, and Santa Fe National Forests and the Taos Pueblo, Santa Clara Pueblo and Navajo Indian Reservations, New Mexico. An additional 130 acres of defoliation occurred on State and private lands in Arizona. On State and private lands in northern New Mexico, defoliation to aspen increased slightly. Western tent caterpillars appeared to be the primary cause of this defoliation. High numbers of this insect were reported in aspen stands east of Santa Fe, scattered in stands between the Black's Peak and White's Peak area, and the Rio Costilla area in northern New Mexico.

Table 1. Status of other insects occurring in Arizona and New Mexico--continued

Insect	Host	Location	Remarks
True Fir Mortality *Scolytus ventralis* (in white fir); *Dryocetes confusus* (in subalpine fir) *Armillaria* spp. *Heterobasidion annosum*	White Fir Subalpine fir	Arizona, New Mexico	True fir mortality resulting from this insect and disease complex remained relatively unchanged from 1992 levels. In 1992 mortality was detected on 2,450 acres and in 1993 on 2,330 acres. Groups of dead fading firs were observed Apache-Sitgreaves, Coconino, and Kaibab National Forests, Fort Apache Indian Reservation, Arizona and the Cibola, Lincoln, and Santa Fe National Forests and the Mescalero and Navajo Indian Reservations, New Mexico. Estimated volume losses from this insect and disease complex approximated 246,800 cubic feet.

STATUS OF PREDOMINANT DISEASES IN 1993

Dwarf mistletoes, Arceuthobium spp.

Dwarf mistletoes are the most widespread disease-causing agents in the Southwestern Region. Approximately 1,040,00 acres of National Forest lands are infected by dwarf mistletoes in Arizona, and 1,140,000 in New Mexico. Recent surveys suggest that the incidence of southwestern dwarf mistletoe of ponderosa pine has increased from 30 to 38 percent over the past thirty years. The increase is believed to be the result of human activities such as suppression of wildfires, inappropriate harvesting practices, and lack of priorities for treating infested stands. The other dwarf mistletoes have probably increased for the same reasons.

True mistletoes, Phorodendron spp.

The true mistletoes may be less damaging than their dwarf counterparts because they manufacture much of their own food. However, there are many woodland areas in the National Forests, National Parks, and Indian Reservations of the Southwest that are greatly impacted by these green parasites. Heavily infected areas appear to suffer significant growth loss and mortality, particularly during periods of severe moisture stress, however, we are just beginning to quantify the effects of true mistletoes.

White pine blister rust

This non-native fungal disease (Cronartium ribicola) occurs nearly throughout the range of southwestern white pine (Pinus strobiformis) in the Sacramento and White Mountains of Southern New Mexico. Nearly half a million acres are affected. This area contains what is probably the largest population of this tree species in the world. The rust will have a severe impact during the next several decades.

Efforts are being made to reduce the chance of the disease being spread to other parts of the Region, and we are exploring opportunities to work with genetic resistance to the rust.

Ponderosa pine needle cast, Lophodermella cerina

Ponderosa pine needle cast was detected on 7,280 acres of host type in 1993 compared to 19,000 acres in 1992. This disease was detected on 400 acres of the Carson National Forest, 2,480 acres on the Cibola National Forest, 1,640 acres of the Gila National Forest, 40 acres of the Lincoln National Forest, 2,400 acres of the Santa Fe National Forest, 160 acres of the Mescalero Apache Indian Reservation, and 160 acres of the Navajo Indian Reservation. On State and private lands in New Mexico, ponderosa pine needle cast was noticeable along the highway north of Mora, through Cimarron Canyon, and north on Vermajo Park lands. Heaviest damages were seen in Sugarite Canyon in Colfax county.

Winter Injury

Winter injury was observed in groups of ponderosa pine trees, ranging from 1 acre up to several hundred acres in size, in forests in northern Arizona. In early spring, discoloration of needles occurred throughout the crown of affected trees. As spring progressed, the older needles fell off, leaving only current-year needles on living branches. Approximately 5,000 acres were affected, with most of the injury occurring on the Coconino National Forest (4,600 acres) with lesser amounts on the Kaibab NF (315 acres) and White Mountain Apache Indian Reservation (110 acres).

Ice Damage

Snow and ice damage was observed on approximately 945 acres of spruce-fir forest type on Mt. Graham, Safford Ranger District, Coronado National Forest. The most severe damage occurred on about 20 acres of Heliograph Peak where 90 percent of the trees were severely damaged (especially bole breakage). Since a significant amount of large slash material was generated, insect outbreaks caused by spruce beetle, Douglas-fir beetle, or Ips beetles are anticipated if the slash is not treated. FPM is helping the District monitor insect populations.

Table 2. Status of other diseases occurring in Arizona and New Mexico

Disease	Host	Location	Remarks
STEM AND BRANCH DISEASES			
Red rot *Dichomitus squalens*	Ponderosa pine	Arizona, New Mexico	Red rot decay is distributed throughout the Region and is the most common cause of decay in living ponderosa pine in the Southwest.
Red ring rot *Phellinus pini*	Douglas-fir, Ponderosa pine, Spruce, True firs	Arizona, New Mexico	*Phellinus pini* is indigenous to mature and overmature stands of pine and mixed conifers. Its distribution is scattered and losses and damages are minimal in most stands.
Rust-red stringy rot *Echinodontium tinctorium*	White Fir	Arizona, New Mexico	This fungus is found in mature and overmature stands of mixed conifers.
Aspen trunk rot *Phellinus tremulae*	Aspen	Arizona, New Mexico	Aspen trunk rot is the most common cause of decay in mature aspen stands throughout the Region.
Atropellis canker *Atropellis* spp.	Southwestern White Pine	New Mexico	This canker disease is common and locally abundant on the Lincoln National Forest and Mescalero Apache Indian Reservation, but is not causing major damage.
Aspen stem cankers *Encoelia pruinosa* *Ceratocystis fimbriata* *Cryptosphaeria populina* *Hypoxylon mammatum* *Cytospora chrysosperma*	Aspen	Arizona, New Mexico	These canker fungi cause significant reductions in growth and vigor of mature aspen stands. In Region 3, stands often have over 30-percent infection with canker fungi. In campgrounds, stem cankers are typically more prevalent due to damage from campers.

Table 2. Status of other diseases in Arizona and New Mexico--continued

Disease	Host	Location	Remarks
Spruce broom rust *Chrysomyxa arctostaphyli*	Spruce	Arizona, New Mexico	Spruce broom rust is scattered throughout the host type but is of little commercial significance.
Comandra blister rust *Cronartium comandrae*	Mondell pine, Ponderosa pine	Arizona	Comandra blister rust occurs on exotic mondell and native ponderosa pines in the Payson, Sedona, and Prescott areas. Damage is to individual trees in landscape areas and Christmas tree plantations.
Fir broom rust *Melampsorella caryophyllacearum*	True firs	Arizona New Mexico	Fir broom rust is widely distributed throughout the subalpine, corkbark, and white fir habitat types in the Southwest. Damages typically consist of stem and branch swellings, dead tops, and stem breakage.
Limb rust *Cronartium arizonicum* *Peridermium filamentosum*	Ponderosa pine	Arizona	Small group (2 to 3 trees) infections are located throughout the ponderosa pine forests of the Southwest.
ROOT DISEASES			
Black stain root disease *Leptographium wageneri* var. *wageneri* and var. *pseudotsugae*	Pinyon pine Douglas-fir	Arizona, New Mexico	Both *Leptographium wageneri* var. *wagneri*, which infects pinyon, and *L. wagneri* var. *pseudotsugae*, which infects Douglas-fir, are rare in the Southwestern Region. The former is confined to two isolated areas in northern New Mexico, and the latter has been observed only in sites in south-central New Mexico.

Table 2. Status of other diseases in Arizona and New Mexico--continued

Disease	Host	Location	Remarks
Annosus root disease *Heterobasidion annosum*	Douglas-fir, ponderosa pine, spruce, true firs	Arizona, New Mexico	Root diseases and their associated pests are responsible for about one-third of the conifer mortality Regionwide. *Armillaria* spp. account for about 80
Armillaria root disease *Armillaria* species	Douglas-fir, ponderosa pine, true firs	Arizona, New Mexico	percent of this mortality, while *Heterobasidium annosum* and other root disease fungi account for the remaining 20 percent. A greater percentage of the

Table 2. Status of other diseases in Arizona and New Mexico--continued

Disease	Host	Location	Remarks
Schweinitzii butt rot *Phaeolus schweinitzii*	Douglas-fir, True firs	Arizona, New Mexico	mixed conifer and spruce-fir forests are infected compared to ponderosa pine type. Region 3 is working to fill gaps of knowledge on the occurrence and effects of
Tomentosus root rot *Inonotus tomentosus*	Spruce	Arizona, New Mexico	Armillaria and other root diseases in Southwest forests. In 1993, *H. annosum* was observed in many white fir trees attacked by fir engraver beetles on the North Kaibab Ranger District.
White mottled rot *Ganoderma applanatum*	Aspen	Arizona, New Mexico	Scattered throughout the host type. This fungus causes windthrow.FOLIAGE DISEASES
Elytroderma deformans	Pinyon pine, Ponderosa pine	Arizona, New Mexico	Elytroderma disease is widely distributed but at low levels.
ABIOTIC DISEASES			
Salt damage	Ponderosa pine	Arizona, New Mexico	Needle discoloration was observed along roads in the higher elevations, due to salt used for deicing. Salt damage was also observed on dirt roads in Arizona where salts were used for dust abatement.

TECHNOLOGY DEVELOPMENT

Roundheaded pine beetle trapping study

In 1992-93 as part of a technology development project we conducted a roundheaded pine beetle (RPB) trapping study, in cooperation with Pat Shea, Pacific Southwest Forest and Range Experiment Station, to determine the beetle's flight periodicity (number of flights per year) and reaction to the anti-attractant compound, verbenone. We used the western pine beetle bait (high release rate of exo-brevicomin and frontalin with myrcene) as the attractant and five blends of verbenone as the anti-attractant. The bait and anti-attractant blends and bait alone replicated 10 times per treatment were placed in the middle funnel of a 16 funnel Lindgren trap. The traps were distributed along roads and collections were done weekly. The main flight of RPB occurred from around the third week of September until the last week of November, 1992 or approximately 10 weeks. There were minor flights of about six weeks with low RPB catches and seven weeks with low to moderate RPB catches beginning in the first week of June, 1992 and the second week of March, 1993, respectively. Four of the five anti-attractant blends reduced the catch of RPB by 96% on the average. The other blend reduced the catch by 74% on the average but was not significantly less effective than the other blends.

The 1993-94 technology development project was a repeat of the 1992-93 test except the June flight was used to determine what concentration and combination of bait compounds (for the Sacramento Mountains, New Mexico and Pinelano Mountains, Arizona) was the best for maximizing the catch of RPB. We tested two different concentrations of exo-brevicomin and frontalin and three pine terpenes (myrcene, alpha-pinene, and beta-pinene) in eight different combinations with an empty trap as a control. These treatments were replicated five times in New Mexico and four times in Arizona. We found that the low release rates for both exo-brevicomin and frontalin at both locations caught as many or more RPB as any of the other seven treatments. The anti-attractant test with this bait was run only in New Mexico for 10 weeks in the fall. The beetle counts are not complete for this part of the test.

Effects of slash management practices and overstory density on Ips spp. brood production in ponderosa pine slash

In cooperation with Northern Arizona University, the Region is partially supporting two projects examining effects of slash management practices and overstory density on Ips brood production. The purpose of these projects is to evaluate effectiveness of cultural treatments designed to reduce risk of Ips bark beetle population buildup in slash following thinning. These studies are being conducted by Jaime Villa-Castillo and Victoria Wesley at the direction of Dr.'s Mike Wagner, Northern Arizona University, and Jill Wilson, Forest Pest Management, Southwestern Region.

Jaime Villa-Castillo is examining the effect of overstory density on pine engraver, Ips pini, brood production in ponderosa pine slash slash in Northern Arizona. The primary objective of his study is to determine the effect of overstory density on Ips pini population dynamics in ponderosa pine slash. In 1993 he examined the effects of four thinning intensities on light intensity, heat flux density, log moisture (top and bottom), as well as Ips attack and egg gallery density, Ips egg and larval gallery lengths, and Ips productivity (ratio of brood emergence to attacks). All the Ips variables were measured on both the top and bottom of the logs.

Victoria Wesley is evaluating the effects slash piece size, both diameter and length, on Ips spp. population dynamics. This project is being conducted for Ips pini and I. lecontei, Arizona five spined Ips, at two locations in southeastern Arizona. One of the main objectives of her study is to examine efficacy of cutting slash pieces into shorter lengths to reduce Ips brood production. The primary assessment procedure she is using to determine seasonal production of Ips will be the ratio of brood production (emergence) to attack rates.

Establishment of permanent plots

In 1993, 24 permanent plots were established as part of the "Pest Trend Impact Plots in the West" technology development project. The purpose of the project is to establish and monitor permanent plots in areas affected by specific insects and diseases and use the information to validate the pest subroutines of the Prognosis growth and yield model. Eleven of the 24 plots were in areas infested with western spruce budworm, eight of the plots were in root diseased areas, and the last 5 plots were established in areas infected with southwestern dwarf mistletoe. Also, 6 dwarf mistletoe permanent plots established in Arizona in 1991 were checked for mortality in 1993.

PREVENTION AND SUPPRESSION PROJECTS

Table 3. Dwarf Mistletoe Presuppression Surveys and Suppression Projects Conducted During 1993 on National Forest and Bureau of Indian Affairs Trust Lands.

Federal Agency	Presuppression Survey Acres	Suppression Project Acres
National Forest		
Carson		885
Coconino		580
Kaibab	2,000	650
Lincoln		55
Santa Fe		359
Tonto	11,000	22,000
Reservation		
Acoma		305
Fort Apache	30,000	
Mescalero		1,190
Santa Clara		45

DETECTION

Aerial Detection Surveys

Over 9.4 million acres of Federal lands in Arizona and New Mexico were surveyed during July through September 1993. Forest Pest Management surveys nearly all forested land in the Region (except pinyon -juniper woodlands) annually. Other areas, including pinyon-juniper woodlands, are flown on request. Ground examinations are often made to confirm observations. Upon completion of the surveys, maps showing the type, location, and extent of insect and disease activity are prepared and sent to the respective administrative units. Aerial surveys are a cost effective way of detecting major forest pest activity. Done annually, they provide an excellent way to monitor changes in pest activity over time. State pest management specialists conduct aerial and ground surveys on State and private lands. The Arizona Zone Office is cooperating with the Arizona State Land Department in digitizing aerial survey data and producing maps with a geographical information system (GIS). Digital files were also provided to National Forests for input into GIS.

TECHNICAL ASSISTANCE

Input to Resource Management Planning

Personnel from Forest Pest Management ensure that forest health considerations are incorporated into land management decisions by providing input on forest insects and diseases and their effects on resource management to regional and forest level planning efforts as well as to numerous forest plan implementation projects, including area resource analyses, timber sales, recreation area analyses, etc. In 1993, FPM staff members provided input to over 25 different projects and/or analyses throughout the Region.

Training

The Forest Pest Management staff in the Southwestern Region offers training to personnel from the USDA Forest Service, USDI Bureau of Indian Affairs and National Park Service, as well as other interested federal and state agencies and tribal resource management agencies on a variety of subjects related to forest insect and disease management. Three main types of sessions are offered: 1) Forest Pest Identification and Hazard Tree Management in Recreation Areas, designed for recreation managers, 2) Identification, Effects, and Management of Forest Insects and Diseases, for resource specialists who participate on interdisciplinary teams where forest insects and diseases are a management concern, and 3) Forest Insect and Disease Identification, informal sessions intended for field going personnel including markers, stand examiners etc.

This years formal sessions were cancelled due to an insufficient number of registrants, the result of decreased travel budgets within the Region. However, staff members from both the Arizona and New Mexico Zones gave informal workshops upon request. For example, a mini-course

was given on the detection, management, and reduction of hazard trees in developed recreation sites to resource managers on the Coronado NF. Also, resource managers with the BIA on the Mescalero Apache Reservation were given a presentation on the biology, ecology and management of insects and diseases of southwest forests.

Biological Evaluations

Through biological evaluations, pest management specialists provide information to affected land management agencies on new or existing insect and disease outbreaks or infestations. In a biological evaluation, the specialist reports on the current status and expected population trends of the insect or disease of concern, describes resource and ecological effects of insect or disease activity and discusses alternatives for management.

In 1993, staff members from FPM conducted 31 separate biological evaluations throughout the Region. They are listed below.

Arizona

1. Biological evaluation of insect and disease conditions in the Bear Canyon Lake Recreation Area, Chevelon Ranger District (RD), Apache-Sitgreaves National Forest. 3420 letter, 2/93.

2. Re-evaluation of Ips guidelines in the Wildland/Urban Interface, Prescott National Forest. 3420 letter, 4/93.

3. Biological evaluation of Cave Springs campground bark beetle prevention project for fiscal year 94, Coconino National Forest. 3420 letter, 5/93.

4. Biological Evaluation of the: Kaufman III, Pumpkin II, Brannigan, and Oak Dwarf Mistletoe Suppression Projects proposed for 1994, on the Chalender and Williams Ranger Districts (RD), Kaibab National Forest. 3420 letter, 6/93.

5. Southwestern dwarf mistletoe in an area proposed for campground development, Long Valley Ranger District. 3420 letter, 7/93.

6. Bark beetle hazard assessment for selected alternatives for management of the Northern Goshawk on the Kaibab Plateau. 3420 letter, 8/93.

7. Biological evaluation of the Pine Creek dwarf mistletoe suppression project, Chino Valley Ranger District. 3420 letter, 8/93.

8. Biological Evaluation of the 1993 and 1994 Dude fire dwarf mistletoe suppression projects, nayson Ranger District. 3420 letter, 8/93.

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10. Biological evaluation of risks associated with bark beetles in the Trick fire area, Peaks Ranger District. 3420 letter, 10/93.

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2. Dry Burnt and Sixteen Springs Dwarf Mistletoe Control Projects, Cloudcroft
and Mayhill Ranger Districts, Lincoln National Forest. 6/3/93.

3. Hornbuckle Dwarf Mistletoe Control Project, Cloudcroft Ranger District,
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4. Cimarron Dwarf Mistletoe Control Project, Valle Vidal Unit, Questa Ranger
District, Carson National Forest. 6/6/93.

5. Western Spruce Budworm Larval Survey, Camino Real Ranger District, Carson
National Forest. 6/21/93.

6. Evaluation of Spruce Trees at Los Conchas Campground, Jemez Ranger District,
Santa Fe National Forest. 7/2/93.

7. Evaluation of Pinon Dieback, Tres Piedras Ranger District, Carson National
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8. Monitoring of the Stand 100 Dwarf Mistletoe Suppression Project, Espanola
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9. Valle Grande Dwarf Mistletoe Control Project, El Rito Ranger District,
Carson National Forest. 7/19/93.

10. Cedar Canyon Dwarf Mistletoe Control Project, Jicarilla Apache Indian
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11. Johnson Woodland Project, Zuni Indian Reservation. 8/31/93.

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16. Sheep and Garcia Forest Health Projects, Espanola Ranger District, Santa
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17. Palmer II and Cunningham Dwarf Mistletoe Control Projects, Tres Piedras
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18. Seally Dwarf Mistletoe Control Project, Questa Ranger District, Carson
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19. Monitoring of the Valle Grande Dwarf Mistletoe Control Project, El Rito
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